BLUESTONE NATIONAL SCENIC RIVER
and
GAULEY RIVER NATIONAL RECREATION AREA

Fecal Coliform Study

April-September
1991

National Park Service
New River Gorge National River
Division of Resource Management
and Visitor Protection
Resource Management Section

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&
GAULEY RIVER NATIONAL RECREATION AREA

FECAL COLIFORM STUDY
APRIL-SEPTEMBER
1991

Submitted by:
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For New River Gorge National River
Resource Management and Visitor Protection
Resource Management Section

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Introduction

This report presents the data from the 1991 fecal coliform study for the Bluestone National Scenic River and the Gauley River National Recreation Area and is a continuation of the water quality studies conducted at the New River Gorge National River (NERI) since 1980. Any visible trends between fecal coliform counts and stage level and 48 hour precipitation (48prcp.) will be discussed and recommendations for 1992 will be presented.

NERI was established by the United States Congress in 1978 and placed under management of the National Park Service (NPS), part of the United States Department of the Interior. A 62,000 acre corridor along 52 miles of New River was set aside ". . . to conserve and interpret the outstanding natural, scenic, and historic values and objects in and around the New River Gorge and preserve as a free-flowing stream an important segment of the New River in West Virginia for the benefit and enjoyment of future generations. . ." (WVDNR 1987-88, p.1). On October 26, 1988 the United States Congress approved Public Law 100-534. Title II, Section 201 of this act established the Gauley River National Recreation Area (GARI). Title III, Section 301 designated the Lower Bluestone as a Wild and Scenic River (BLUE). The purpose of the public law was "an act to protect and enhance the natural, scenic, cultural, and recreational values of certain segments of the New, Gauley, Meadow and Bluestone Rivers in West Virginia for the benefit of present and future generations, and for other purposes." Since this law was enacted NERI has been in the process of developing and managing these two areas in accordance with their lawful designations.

Bluestone National Scenic River is a 10.5 mile stretch, in Summers and Mercer Counties, on the lower section of the Bluestone River. The scenic river flows northeast through a pristine corridor from the southern boundary of Pipestem State Park to one half mile upstream (south) of the Bluestone State Park Boundary (see Figure 1). This downstream (northern) border corresponds with the summer pool elevation, 1410 feet above sea level, of Bluestone Lake (Reservoir). The upper (southern) 3.5 miles of the BLUE lie within the boundaries of Pipestem State Park, the last 7.0 miles lie within the Bluestone Public Hunting and Fishing area (Sprague report 1991, p. 1).

Table 1.

Bluestone National Scenic River
and
Gauley River National Recreation Area
Fecal Coliform Sampling Site Locations

Map Code (Figure 1.)	Station Location
	Bluestone National Scenic River
1-T	Little Bluestone near Bluestone River Confluence
2-M	Bluestone River near Bluestone State Park
3-M	Bluestone River at Pipestem State Park
4-M	Bluestone River near Little Bluestone Confluence
(Figure 2.)	**Gauley River National Recreation Area**
1-M	Gauley River at Summersville Dam.
2-M	Mid Gauley upstream of the Peter's Creek Confluence
3-T	Peter's Creek at Gauley River Confluence
4-M	Gauley River at South Side Swiss

Figure 1: A map of the sampling area for the fecal coliform study at BLUE.

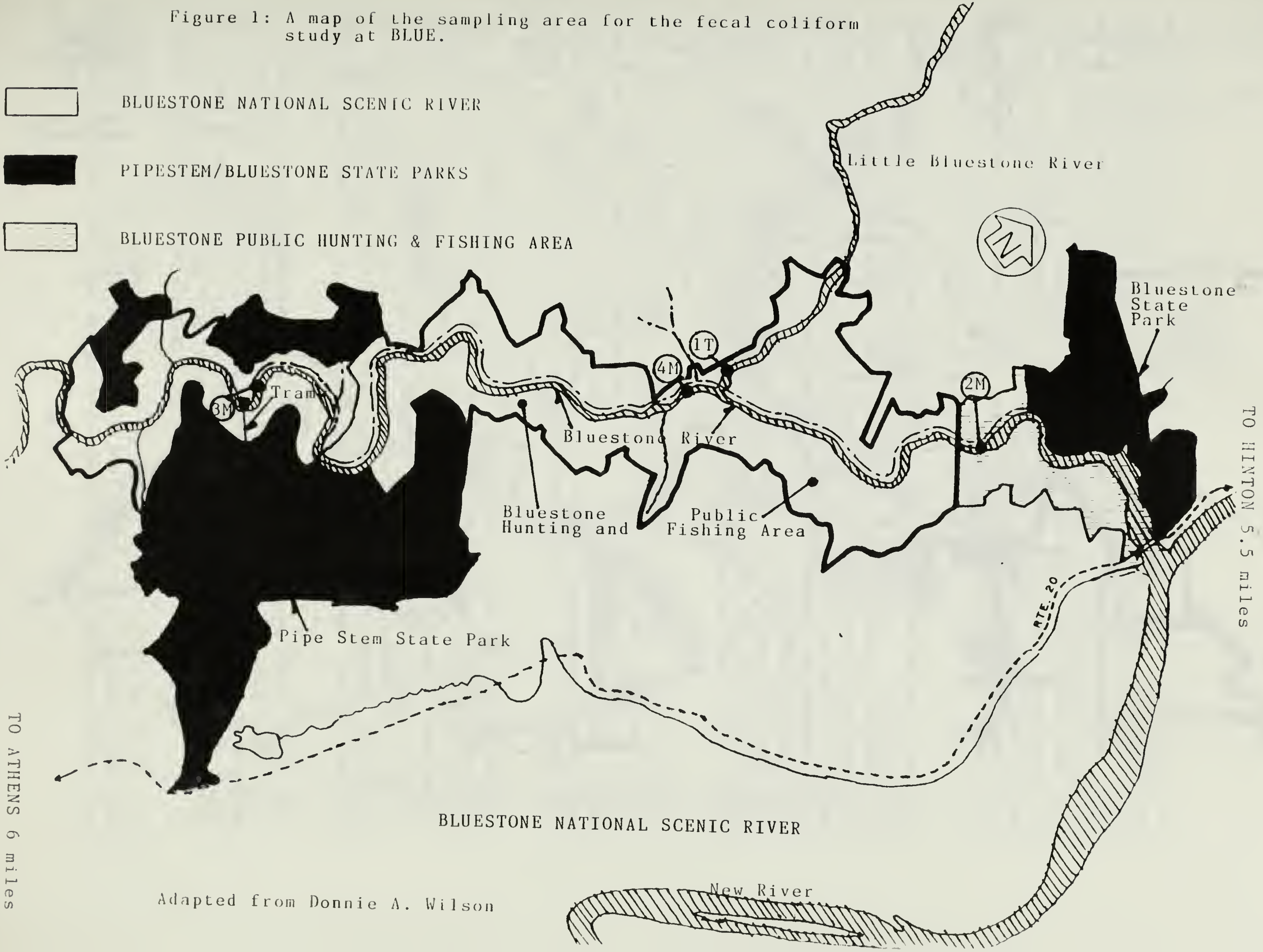
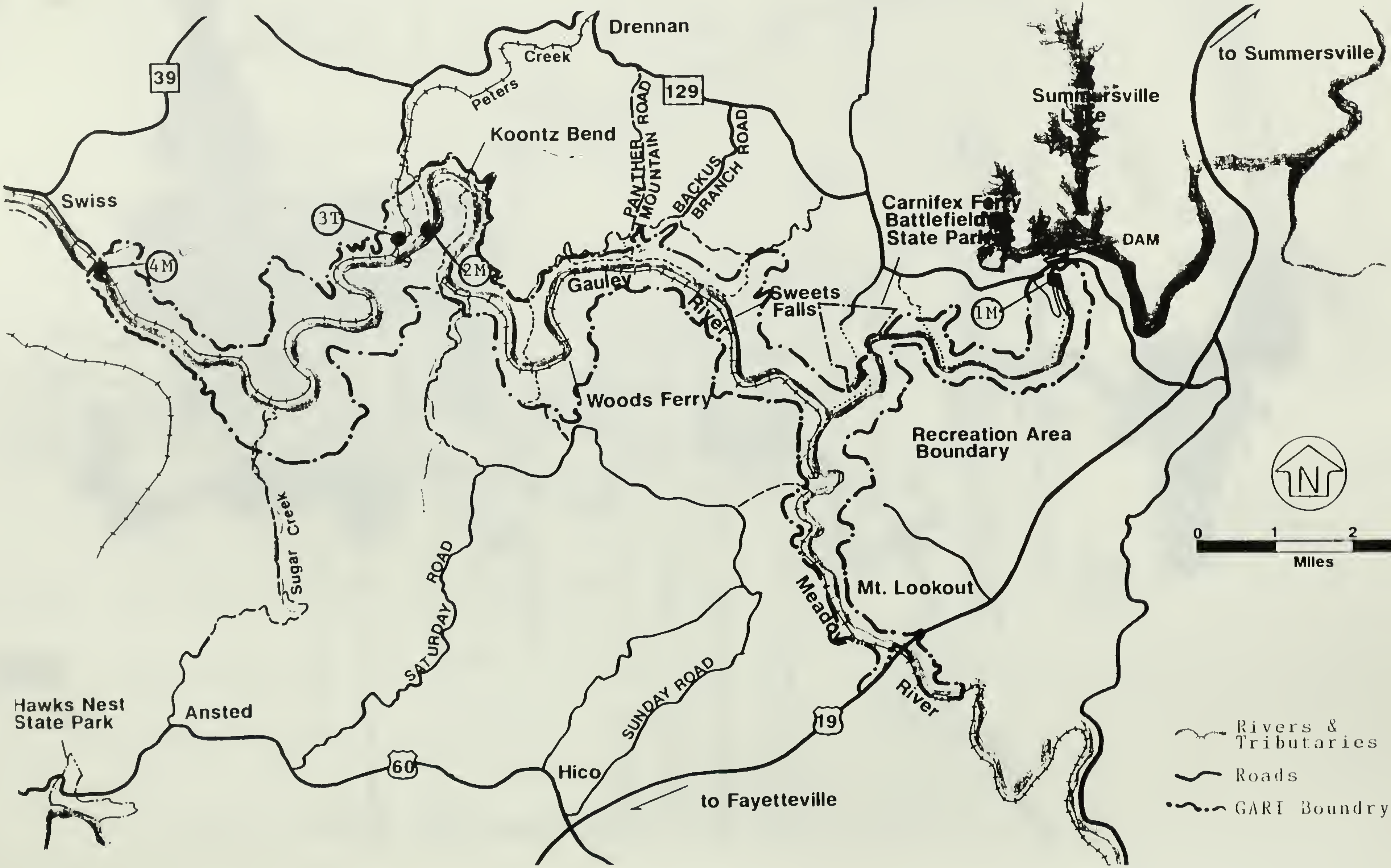

BLUESTONE NATIONAL SCENIC RIVER
PIPESTEM/BLUESTONE STATE PARKS
BLUESTONE PUBLIC HUNTING & FISHING AREA
Little Bluestone River
N
Bluestone State Park
TO HINTON 5.5 miles
1T
4M
2M
3M
Tram
Bluestone River
Bluestone Hunting and Public Fishing Area
Pipe Stem State Park
RTE. 20
BLUESTONE NATIONAL SCENIC RIVER
New River
TO ATHENS 6 miles
Adapted from Donnie A. Wilson

Figure 2: A map of the sampling area for the fecal coliform study at GARI



The headwaters of the Bluestone River begin above 3500′ on the north facing slope of East River Mountain, near Springville, Virginia. The river flows east and then north for 17 miles before entering West Virginia, west of Bluefield. The river then turns northeasterly for 60 miles where it joins the New River south of Hinton. On it's journey to the New River, the Bluestone cuts through the linear Appalachians and then, as it turns northeast, it follows the margin between Allegheny Plateau and the folded Appalachians. At Eads Mill, West Virginia, the river begins to constrict in its gorge. The wall elevations vary from 300′ up to 1200′ (BLUE report, 1983, p. 13).

The water quality on the lower section was considered satisfactory in a 1983 report (BLUE report, 1983, p. 21). It was also classified by the state as a high quality warmwater stream, in relation to fisheries. The major water quality problems lie upstream, where the river runs through a wider floodplain, making it more susceptible to domestic and municipal sources of pollution (BLUE report, 1983, p. 13). The river is affected slightly by strip mining activities that contribute acid mine drainage and siltation. Farming, construction, and exposed soils, due to fire and logging, also contribute siltation loads to the river (BLUE report, 1983, p. 17).

The Gauley River National Recreation area (GARI) is in south-central West Virginia near Summersville. GARI encompasses 25 of the last 35 miles on the Gauley River and the lower 5.5 miles of the Meadow River. (See Figure 2). GARI begins just below Summersville Dam and flows west to Swiss, ten miles below this western boundary the river joins the New River at Gauley Bridge (GARI report, 1983, p. 12).

The Gauley watershed lies within the eastern edge of the Allegheny Plateau, and includes many popular tributaries including the Cranberry River, Cherry River, Williams River, and the Meadow River. The mainstem of the Gauley, flowing off Gauley Mountain, forms at the Webster-Randolph county line by the confluence of the north, south, and middle forks of the Gauley (U.S. EPA, 1981, p. 2-1). The highest point in the watershed is Big Spruce Knob, in Pocahontus county. This 4695′ knob contributes runoff to the Williams River.

The Recreation area contains a narrow, rugged gorge with walls 500′ to 800′ high and vertical drops over 100′. This pristine section of river is a series of pools and drops with several rapids rated at class V and several rated at V+ in difficulty. The Gauley River is considered one of the top rated commercially run whitewater rivers in the United States.

The Gauley River's water quality, as it flows through GARI, is considered to be good, with two exceptions. The Summersville Dam releases water from the lower half of Summersville lake, releasing water at temperatures as low as 10°C and not exceeding 16°C. These low temperatures limit the quality of the warmwater fisheries that used to occur in this area (U.S. EPA, 1981, p. 2-45). A second degrading effect is the silt and sediment introduced by poor forestry and strip mining practices in the Gauley Watershed (GARI report, 1983, p. 21). With the addition of both BLUE and GARI to the NPS managed areas, NERI staff decided to bring them in line with the fecal studies being performed on the New River. The following is a brief overview of these water quality studies.

In 1980 NERI began a water quality program, on the New River, to build baseline data upon which future monitoring and management activities could be based. At that time NERI lacked proper laboratory facilities to carry out this program, so it joined in a cooperative agreement with the West Virginia Division of Natural Resources (WVDNR). From 1980 to 1984 the WVDNR did water quality studies to enhanced its own water quality data baseline and to assist the NPS. These studies looked at several parameters commonly related with commercial and domestic pollution (ie. total aluminum, total cyanide, total iron, fecal coliform etc.). After examining the data from 1980-1984, NERI determined that sewage and/or animal wastes were a major cause for concern because of the large amount of human body contact on the New River. In 1985 NERI attempted to begin monitoring for fecal coliform, the accepted indicator for sewage and animal waste contamination (SM 901A.), with Colicount samplers (from Millipore Corporation). This method is quick and inexpensive but it is not an EPA approved method. An unpublished report by NERI on the 1985 sampling effort recommended the use of an approved standard method and an approved laboratory for future bacteria monitoring efforts.

In 1986, based on these recommendations, NERI coordinated with the USDA Appalachian Soil and Water Research Lab Facilities to use their lab to analyze fecal coliform samples. The Membrane Filter technique (SM909C), an EPA approved analytical method, was used with satisfactory results. In 1987, because of staff changes at NERI and inconsistency of the 1986 data, it was decided again to contract with the WVDNR to do fecal coliform studies on the New River and selected tributaries. The result of this agreement was the "New River Gorge National River Fecal Coliform Study, April-September, 1987-1988" done by WVDNR. In 1990, in an effort to train personnel and begin the set-up of an approved water quality lab, NERI staff took over the fecal coliform studies from WVDNR and again conducted the studies with assistance of the USDA lab in Beckley. Over the winter of 1990/91 much preparation was done for the debut of the 1991 fecal coliform study, performed by NERI staff in the newly equipped NERI Water Resources Lab. The 1991 study involved not only the New River but also the Bluestone and the Gauley. In future years NERI is planning to carry out at least 6 more parameters on these sites on a quarterly basis.

MATERIALS AND METHODS

The study was conducted in south central West Virginia at the Bluestone Scenic River and the Gauley River National Recreation Area. The Bluestone River in the BLUE flows through Summers and Mercer Counties. All but one of the four sample sites are in the Scenic River Boundary. The one outside of BLUE's boundary is 2-M, Bluestone River near the southern boundary of Bluestone State Park. GARI flows through Nicholas and Fayette Counties. All of the sampling sites for GARI are in the Recreation Area Boundary. The sampling sites are listed in Table 1, and Figure 1 and 2 show their relative locations. For the sample sites in Figure 1 and 2 and Table 1, "M" denotes mainstem sites while "T" indicates tributary sampling sites. The tributary sites were sampled as close to the mainstem confluence as possible in order to give an adequate assessment of all the pollutants entering the river. Mainstem sites were sampled at areas of high public contact and as close to the main current as possible.

The sampling sites were divided into two districts, BLUE and GARI. Each district was sampled biweekly on alternate weeks. For example, if the BLUE district was sampled on the 1st and 3rd weeks of the month, the GARI district would be sampled on the 2nd and 4th weeks.

The time period of collection coincided with the summer recreational season for the two rivers. The BLUE is subject to seasonal flows since it is not impounded by any upstream dams. Thus the typical flow regime is high in the late winter and early spring (825 cfs.) and low in late summer and early fall (40 cfs.)(BLUE report, 1983, p. 15). So the Bluestone River is used only in the early spring or during very great rain events for whitewater boating. The river is also used for canoeing and fishing throughout the year. A few companies run guided fishing trips on the Bluestone River.

The Gauley is a completely different story. At the upper end of GARI lies the Summersville Dam. This dam controls the flow of the Gauley below this point. Because of this, the river does not demonstrate the drastic flow regime of the BLUE. The river, in GARI, will run high in the spring if the spring runoff brings lake levels up, but the flow will only be about 1500-1800 cfs. This is minuscule compared to the record flow, since 1929, of 105,000 cfs (GARI report, 1983, p. 21). In the summer months the Gauley runs not lower than 200 cfs., usually higher, due to the constant dam control. Then instead of being at its lowest, (the record low since 1929 is 3 cfs.), it runs at 2500 to 3000 during September and the first two weeks in October. The reason for these abnormally high flows is that the Corp of Engineers is lowering the level of Summersville Lake to make room for winter and spring runoff. A second reason is that the rafting industry worked out an agreement with the Corps to have six four-day weekends, Friday through

Monday, to have high enough flows to commercially raft the Gauley. There are approximately 23 whitewater rafting companies that operate commercially during this period. In addition the Gauley River attracts whitewater enthusiasts from around the World.

The river is also used for fishing, camping and other activities during the year. In Summer the weekday pace is slow, but the weekends in September and the first part of October are crowded with rafters, kayakers, and canoeists. Occasionally, temporary high seasonal flows in the Spring and Summer will attract recreationists, but this use is small compared with the use by the Gauley Season crowds. Since BLUE and GARI recreational opportunities are largely based around the river, and most involve body contact, it was decided that fecal coliform would be the minimum criteria to study. As time progresses, other parameters will be added to the scope of the water quality studies at NERI. All of the methods used for the" Bluestone Scenic River and the Gauley River National Recreation: Fecal Coliform Study, April-September, 1991" are found in "Standard Methods for the Examination of Water and Wastewater: 16th Edition," from here on referred to as SM.

Sampling bottles were 250ml and 500ml plastic Nalgene bottles. In order to bind any residual chlorine that may have been released into the streams, a dechlorinization agent was added to the sample bottles; this was done in agreement with SM 906 A.2. The bottles were then sterilized in an autoclave for approximately 15-18 minutes at 127 degrees Celsius and placed in the drying cycle for 15 minutes.

Water samples were collected, according to SM 906 A.3.e., on a biweekly basis. The sample bottles were then placed in a 24 quart cooler with ice and transported, within 6 hours, to the lab for analysis. This complies with SM 906 B.

Once in the laboratory, the samples were analyzed for fecal coliform based on procedures described in SM 909 C. The filtering apparatus was a Millipore OM 037 glass 47mm filter holder. Commercially prepared M-FC media, contained in 2.1ml ampules, and sterile pads/filters (sterilized MSI cellulosic, white grid, 0.45 micron, 47mm., with pad) were used in the filtration. The sample filters were placed in disposable plastic petri dishes and heat sealed in a plastic bag. The bags with the sample filters were incubated for 24 +-2 hours at 44.5 +-0.2°C. After the incubation the fecal coliform densities were calculated according to SM 909 C.3 general formula:

$$\text{Fecal coliform colonies per 100ml} = \frac{\text{Coliform colonies counted} \times 100}{\text{ml sample filtered}}$$

The "West Virginia Water Resources Board for Protection of Recreational Use and Public Water Supply", WVWRB, has set a standard of no more than 200 counts of fecal coliform bacteria per 100ml (WVDNR 1987-88, p.1) expressed as a geometric mean based on no less than five samples per month. The geometric mean can be calculated by one of two formulas:

$$GM = \sqrt[n]{[(FC1)(FC2)\,.\,.\,.(FCn)]}$$

or

$$\left[\frac{(\log FC1) + (\log FC2) + \,.\,.\,.(FCn)}{n}\right]$$

GM = monthly geometric mean

where GM = monthly geometric mean.
FC1, 2. . .n = fecal coliform bacteria value for sample number 1,2. . .n.
n = total number of samples during month (WVDNR 1987-88, p. 9).

Due to fiscal restraints, only two samples were taken per month. Thus the results must be looked at as indicators of streams that may have exceeded the above standard. Interpretation of the results of the 1991 BLUE and GARI study has been based primarily on whether a stream met, or failed to meet, this criterion (NERI 1990, p. 5).

When the samples were taken, date and time were recorded, as well as 8 other parameters. See Appendix A-1. The 8 parameters are water temperature, air temperature, pH, stage level (if applicable), water condition, dissolved O_2, weather, and conductivity. Water temperature and conductivity were determined with a YSI model 33 conductivity meter. The dissolved O_2 was determined with a YSI model 51B dissolved O_2 meter. Air temperature was determined with an alcohol thermometer. PH was detected with a "pH pen" made by Fisher. Water condition and weather were subjectively determined by use of a written scale illustrated in Appendix 2. The stage level for the BLUE run was obtained from the recorded phone message at Bluestone Dam. The stage level for the GARI run was obtained from the staff at Summersville Dam. Gauge phone numbers and information are listed in appendix 3. The 48 hour precipitaiton for the BLUE was received from the Beckley Weather Service. (304 255 5800). The 48 hour precipitation for GARI was received from the staff at Summersville Dam.

RESULTS and DISCUSSION

The concentration of fecal coliform bacteria was examined on 4 sites in both the BLUE and the GARI. In the BLUE, 3 sites are on the Bluestone River and one site is on the Little Bluestone River. In the GARI three sites are on the Gauley River and one site is on Peter's Creek. The following section presents the results of these examinations along with a discussion of violations, in relation to the 48 hour precipitation (48prcp) and water level. It must be noted that use of the term "violation" is relative in this report. The standard for fecal coliform is no more than 200 fecal coliform colonies per 100 milliliters of sample. This will be reported as MFC/100ml, which stands for Membrane Filter Count per 100 milliliters of sample. This part of the standard is legally valid in the context of 5 separate samples per month. If the geometric mean of the 5 samples exceeds 200/100ml, then the sample site is considered to be in violation of the standard. The second part of the standard states that if more than 10% of the samples exceed 400/100ml, then the sample site is also in violation. Since NERI only sampled 2 times per month, the standard cannot be legally applied to our results. However, for this study, a reading of more than 200/100ml will be used to point out bodies of water that may be in violation of the standard.

Each site has a corresponding figure that displays the MFC's for that site in 1991 (Figures 3-10). Appendices 4 and 5 correspond with figures 3-10. Appendices 6 and 7 consist of lists of all the raw data arranged by site and date. Appendix 8 and 9 contain the comments that correspond with the information in Appendices 6 and 7.

The Bluestone National Scenic River Results and Discussion

The flow on the Bluestone and the Little Bluestone demonstrated the characteristics of unimpounded, free flowing streams. In the spring it had a high flow due to increased run off, followed by lower levels in late summer and early fall. These flow regimes have been linked to fecal coliform (FC) levels, with typically high FC levels occurring during high spring flows and lower levels during lower summer/fall flows (NERI 87-88, p. 30). Although stage level was not reported for the first two readings on the main stem sites, the sampler recorded observations that indicated that the flows on 5/16 and 5/28 were excessively high, in comparison with the rest of the season. The first two fecal coliform readings for each site, except 4-M Confluence, were the two highest readings, these were on 5/16 and 5/28. The reason 4-M didn't have a reading on 5/16 is because it wasn't added until 5/28. From this point on, the general trend is for the FC readings to decrease.

1-T, Little Bluestone River near Bluestone River Confluence. (See Figure 3)

The Little Bluestone River is the major side tributary in the BLUE and it enters the Bluestone river about 7 miles downstream of the southern boundary of the BLUE. The Little Bluestone watershed drains in from the west, from a rural, low housing density area. In some areas were the stream plane is wide enough, the river runs through pasture land and near several houses along the margin of the stream. These are two possible sources for waste loads in the river.

At this site one reading of 1400/100ml, on 5/28, was above the standard. One other reading of 168/100ml on 5/16 was near the 200/100ml standard. The rest fall below 100/100ml and the lowest reading was 3/100ml on 8/19. As the season progressed, a clear trend of lower readings during low flow can be seen. No relationship can be seen between the 48 hour precipitation and the FC levels. The highest fecal coliform reading, on 5/28, came on a day of 0.0" 48prcp. The second highest reading, on 5/16, came on the day of highest 48prcp reported as 0.23". A look at Figure 3 will confirm this conclusion.

Even though the recorded precipitation levels were low most of the time, the increased flow in the spring would indicate that there was more water running off the watershed. It is possible that this increased runoff from the pasture land and surrounding areas increased the bacteria levels early in the year. The increased runoff could also be impacted by natural (as in wild animals) waste loads.

2-M, Bluestone River near Bluestone State Park. (See Figure 4)

This site is four-tenths of a mile upstream of the Bluestone State Park Boundary. This puts it very close to, but not in, the boundary of the BLUE. The site is in a riffle on a bend in the river. At this point the river is only accessible by foot and no dwellings are in view. This section of river is in a pristine gorge with a trail running along the river (an old road bed). The major activities in this area are hunting, fishing and boating. Most, if any, developments that exist in the watershed are located 800 to 1000 feet above the river level. It is assumed that most of the fecal coliforms come from upstream or the top of the watershed.
This sample site, of all in the BLUE, had the greatest number of readings above the 200/100ml standard. Three of the first four exceeded 200/100ml. These were 240/100ml on 5/16, 2250/100ml on 5/28 and 208/100ml on 6/25. The third reading on 6/10 was close at 160/100ml. The rest of the readings were below 34/100ml.

One explanation for this site is that the fecals detected in this section flowed in from upstream. Fecals flowing in from the Little Bluestone might have affected the readings at this site. Three out of the first 4 high counts on the Little Bluestone correspond with the first 3 on the Bluestone (2-M). A problem with this hypothesis is that on 6/25 the Little Bluestone had a low count and 2-M had a high count. The Little Bluestone was only 38/100ml while the reading on the Bluestone (2-M) was 208/100ml. Also remember that the first two readings, 5/16 and 5/28, for all the sites ran higher than later readings. The fecal coliform bacteria counts detected on these two days probably flowed in from upstream. The high reading on 5/16 may have been caused by runoff from the local area, since the previous 48 hour precipitation was 0.23".

Another explanation is that the first 3 samplings were taken in a different location, in a side channel. As the water levels went down this side channel dried up. At that time the site was moved to the bend in the riffle. It is possible, that taking the sample in the channel some how enhanced the fecals ability to proliferate. More data will have to be gathered to understand why this area exhibited elevated fecal levels.

3-M, Bluestone River at Pipestem State Park. (See Figure 5)

This site is located on river left just downstream of the Pipestem Lodge. At this point the gorge is narrow and deep and heavily forested. The sample site is located above a small riffle, near the middle of the river. On the west side, on top of the gorge, there are a few scattered farms. These farms are a possible contribution to the natural waste loads that run off the surrounding area.

This site didn't have any readings above the 200/100ml standard. The two highest readings of 100/100ml, occurred during the first two sampling dates, 5/16 and 5/28. It seems the higher flows from upstream contributed to elevated fecal levels. The water quality, in relation to fecal coliform bacteria, at this site seems to be quite good as indicated by the data.

4-M, Bluestone River near Little Bluestone confluence. (See Figure 6)

This site was added during the second week of sampling, which is why there are no data for 5/16. This site is located about two thirds of the way downstream of the southern boundary of the BLUE. The sample was taken off of a ledge in a deep pool with slow moving water. The gorge at this site is narrow, about 800' deep, and heavily forested. On top there are farms with a moderate sized herd of cattle being pastured.

The first reading for this site is the only one above 200/100ml standard for this site. It was 1900/100ml on 5/28. Again this 5/28 date corresponds with high readings for all the other sites. The rest fall below 62/100ml with six being below 26/100ml. As mentioned earlier, the high reading probably corresponds with heavy runoff that occurred upstream of the sampling site. The main problem seems to be in the spring when high flows occur from increased runoff. This runoff carries the waste loads on the land into the stream, causing the fecal coliform levels to increase.

In the BLUE the first two readings for each site, only the second for 4-M, had readings above the standard. As the season progressed and the flow levels decreased, the fecal levels decreased markedly. Three sites had at least one reading above the standard, these were 1-T, 2-M, and 4-M. The site below the Tramway in Pipestem, 3-M, had no readings above the standard. The gorge in the BLUE is primarily a pristine, steep walled gorge. The top of the gorge, on the flat plateau-like areas, is the only developed area. Human dwellings as well as small farms are scattered along the gorge top. These areas of dwellings and farms are probably some of the main contributors to the fecal coliform levels.

A couple of miles upstream on the Little Bluestone, the river flood plain is large enough for a few farms and domestic dwellings. It is possible that runoff from the agricultural sources, as well as some domestic source additions, caused the elevated spring readings. Increased precipitation in the spring may have washed a concentrated supply of fecals into the local watershed.

The Gauley River Recreation Area Results and Discussion

The flow on the Gauley, in GARI, is regulated by the Summersville Dam. This regulation allows the water to flow more consistently throughout the year. The typical high spring flows and low summer flows are not exhibited on this stretch of river. In the spring, the flow is higher because of the excess runoff, but the regulated peak flow is nowhere near what the natural peak flow would have been. In the fall, the flow is much higher than normal, especially during Gauley Season.

1-M, Gauley River at Summersville Dam. (See Figure 7)

This site is below the dam on river right. It is a flat bedrock ledge used as a boating and fishing access. During the Gauley season this is an especially turbulent eddie area. This site exhibited the best water quality, as far as fecal coliform, for any site tested by the NERI staff. All the readings taken were below 9/100ml with seven being 0/100ml.

The water at this site is flowing out of Summersville Lake. The Lake, with its large volume, is able to dilute the quantities of fecal coliform and associated waste organisms flowing into it. Also the long retention of the bacteria in the lake may cause lower levels because of a die off of the fecal coliform bacteria. Thus the readings taken of the water flowing out of the dam reflect the dilution of any fecal coliform present and the reduction due to the long holding time in the lake.

2-M, Gauley River at NARR Campsite. (See Figure 8)

This site is about one third of the way upstream from the western boundary of GARI, just upstream of Peter's Creek confluence. In this area the gorge walls are heavily forested and approximately 500' in height. There are no dwellings near this area.

This site shows a marked increase in fecal levels compared to 1-M, and yet the levels are still lower than most sites. This site had one reading, 275/100ml, that exceeded the standard. This occurred on 8/15. The rest of the readings fell below 46/100ml. This indicates a fairly low level of the indicator organisms. The 48 hour precipitation and stream flow did not seem to directly influence the fecal levels at this site. Figure 8 shows that there is little correlation between fecal coliform bacteria levels and high flow or high 48prcp.

3-T, Peter's Creek at Gauley River Confluence. (See Figure 9)

Peter's Creek is the second largest tributary to enter the Gauley in GARI. It drains a remote, rural area characterized by scattered domestic dwellings, along the middle section of this creek, and mining and timbering tracts in the watershed. Peter's Creek is 17.5 miles long and has a very steep gradient, 57 feet per mile. The Peter's Creek watershed begins near Summersville, in Nicholas County. The only communities of any size are the unincorporated towns of Lockwood, Gilboa, and Zela.

Peter's Creek is affected by mining and timber activity within its basin. The area has been timbered in the recent past but coal mining is by far the principal industry. For every sample taken, this site exhibited milky or murky conditions. This is indicative of exposed soils eroding into the creek. There are obvious contributions of the above industries in this watershed.

This site had six samples above the standard. These occurred on 6/21, 7/3, 7/31, 8/15, 8/29, 9/18. This creek did not exhibit the higher readings in the spring due to increased runoff. The high readings fell in the middle of the sampling regime, late spring, and summer. The highest was 10666/100ml on 8/15. Three other readings were above 1200/100ml. In Figure 9 you can see that the rainfall levels do not directly correlate with the readings above the standard. Three readings above the standard had high rainfall and the other three above the standard had low readings.

One possibility for these readings is the domestic dwellings that lie upstream of the sampling site. There is no documentation of this problem in the past,however it remains a possibility in this area.

Another reason for some of the high readings may have been due to runoff from the local watershed. This could have been the reason for the readings on 7/3, 7/31, 9/18. One problem with this is that the highest reading, 10666/100ml on 8/15 occurred after a low 48prcp of 0.03" of rain. The number of high readings, during both high and normal flows, and at both high rainfall and zero rainfall, would seem to support the possibility of the problem being point sources. A continued influx of domestic waste from dwellings might cause these levels to always be elevated. More research will need to be completed in order to make any definite conclusions.

4-M, Gauley River at South Side Swiss. (See Figure 10)

This site is on river right upstream of Swiss. At this point the gorge widens and the walls are over 1000′ in elevation. The gradient for the river lessens significantly and there is a level floodplain on each side of the river. Laurel Creek runs in below the sampling site.

This site had zero violations in the 1991 sampling year. The highest reading is 95/100ml. The rest fell below 58/100ml. These low readings would seem to indicate that this site is not significantly impacted by Peter's Creek. On Peter's Creeks highest reading of 10666/100ml, this site only registered 20/100ml. Although no definite conclusions can be made with this amount of data, it would seem to indicate that this site is in pretty good condition in relation to fecal coliform.

The overall picture for the three sites on the mainstem in GARI seem to indicate that the animal and human waste levels are within acceptable levels. Of course, much more study is needed in order to draw significant conclusions. Only one of the three sites had a reading above 200/100ml. This was one reading at the Mid Gauley site on 8/15. The rest of the readings were well below the standard.

Peter's Creek, on the other hand does exhibit problems with fecal levels. The problem with fecal coliform lies in the fact that high fecal levels are often indicative of other organisms that are potentially harmful to humans and other organisms living in the stream. The levels on Peter's Creek warrant further study to focus in on problem areas.

Further study is needed in both the BLUE and the GARI in order to gain a better understanding of the influences of point and nonpoint sources of pollution. The BLUE has limited tributaries to be studied, therefore further monitoring on the present sites should be continued. The site on the Little Bluestone should be maintained in order to compile another years worth of data on this creek. Since it is the main tributary in the BLUE a longer record of results is needed to be confident of conclusions made about its water quality. The sites at each end should be sampled again to maintain a reading on the receiving end of the BLUE and on the releasing end. This will aid in detecting changes within the boundary of the BLUE. One suggestion is that 3-M be moved upstream above Mountain Creek and that a site on Mountain Creek be established to monitor its contribution to the Bluestone River. Mountain Creek is the second largest tributary in the BLUE.

Next season the four sites sampled on the GARI should be continued. The upstream site is a valuable control for water flowing into the GARI and the downstream site is good for a comparison with the dam site (upstream site). The difference between these two give a picture of what is happening within GARI. Peter’s Creek was the only site that exhibited readings above the standard almost half of the time (6 out of 13). This site needs continued monitoring to fully assess the condition of Peter’s Creek. It exhibited milky and murky conditions for each time it was sampled as well as having the elevated fecal coliform levels. On GARI there are other significant tributaries entering the Gauley, specifically the Meadow River. The problem with sampling these areas is that the tributaries are quite inaccessible. A site on the Meadow River will be set up just down stream of the U.S. Highway 19 bridge over the Meadow River. Since the program is new on the GARI and the BLUE the same sites will probably be used for a couple of years to build up the data for the April to September time period.

FIGURES EXPLANATION

The following figures represent the fecal coliform data for the 1991 BLUE and GARI fecal coliform study. It should be noted that each chart should be looked at separately. The vertical "y" axis changes from chart to chart, so the figures cannot be compared directly. Also note that the stream level unit is in tenths of feet. The rainfall is the amount of precipitation that fell within a 48 hour period before the date listed.

Figure 3. Fecal Coliform Data for the Little Bluestone River at Confluence

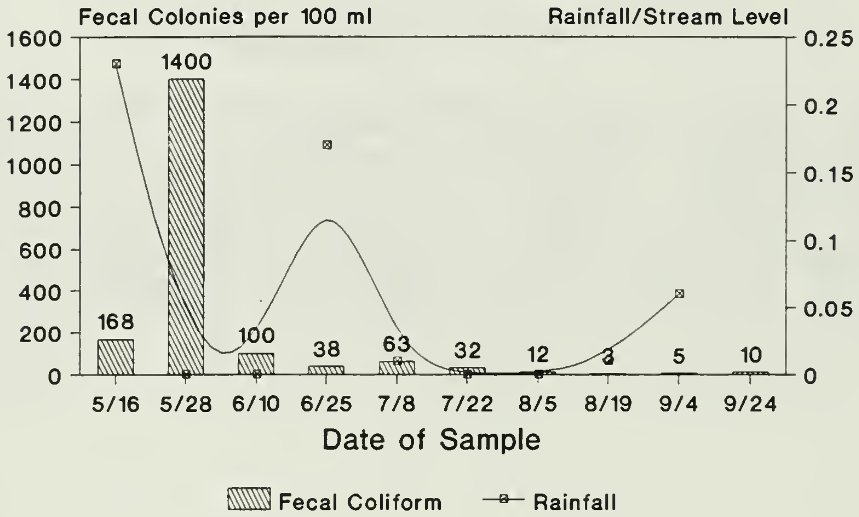


Figure 4. Fecal Coliform Data for the Bluestone River at Bluestone State Park

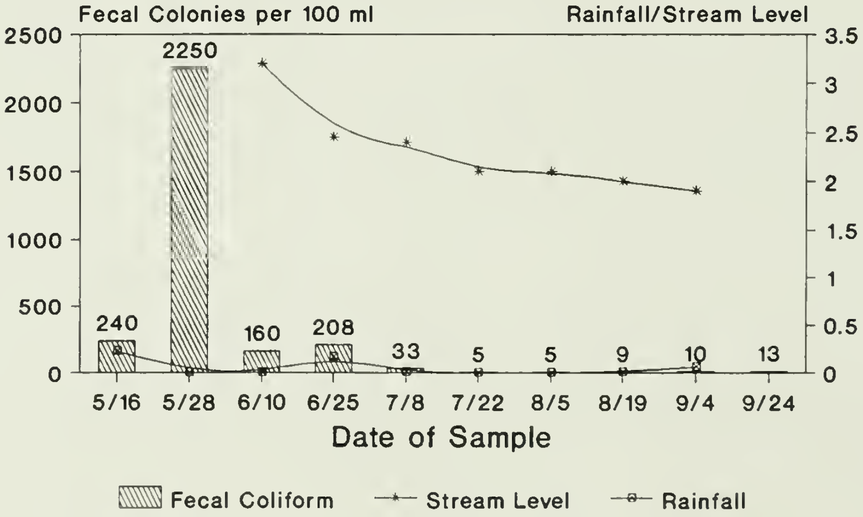
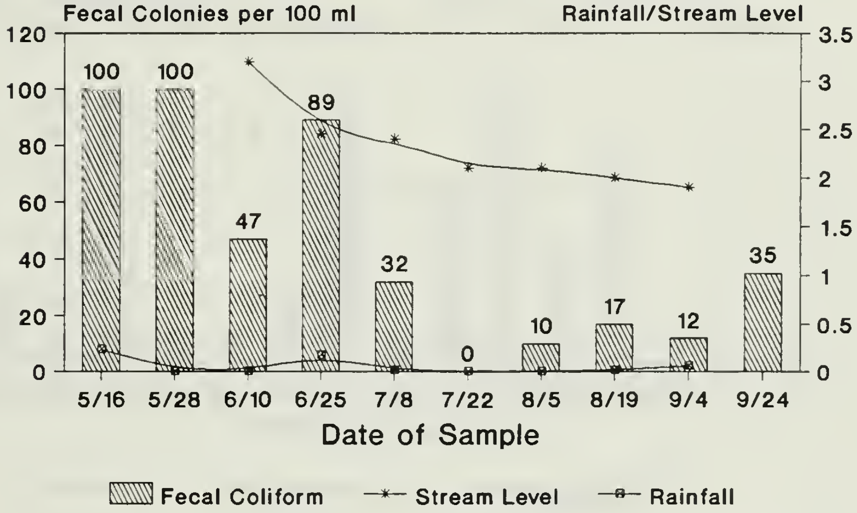


Figure 5. Fecal Coliform Data for the Bluestone River at Pipestem State Park



Site was downstream of the Tramway.

Figure 6. Fecal Coliform Data for Bluestone River at L. Bluestone Confluence

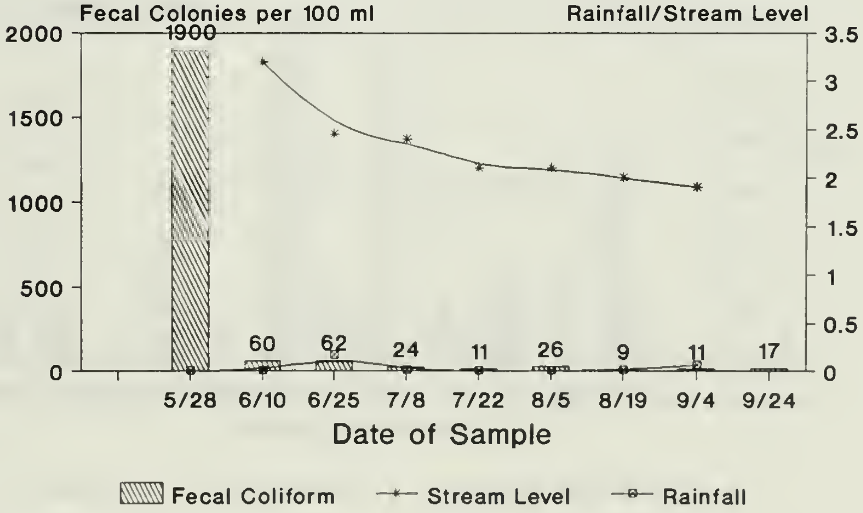
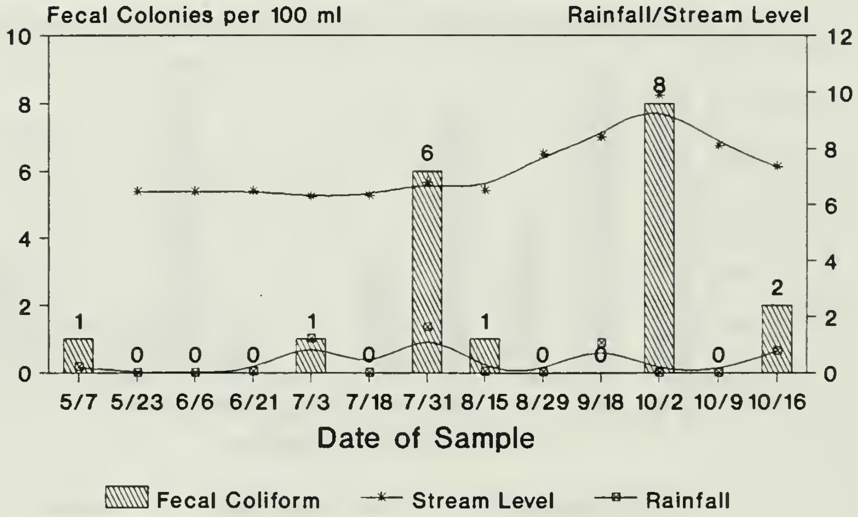


Figure 7. Fecal Coliform Data for the Gauley River at Summersville Dam



At main boaters put in.

Figure 8. Fecal Coliform Data for the Gauley River at NARR Campsite

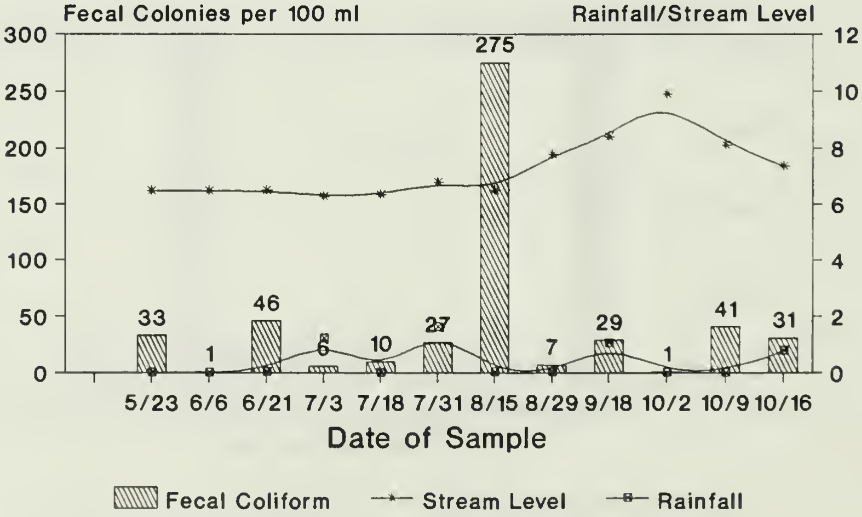


Figure 9. Fecal Coliform Data for Peter's Creek at Gauley River Confluence

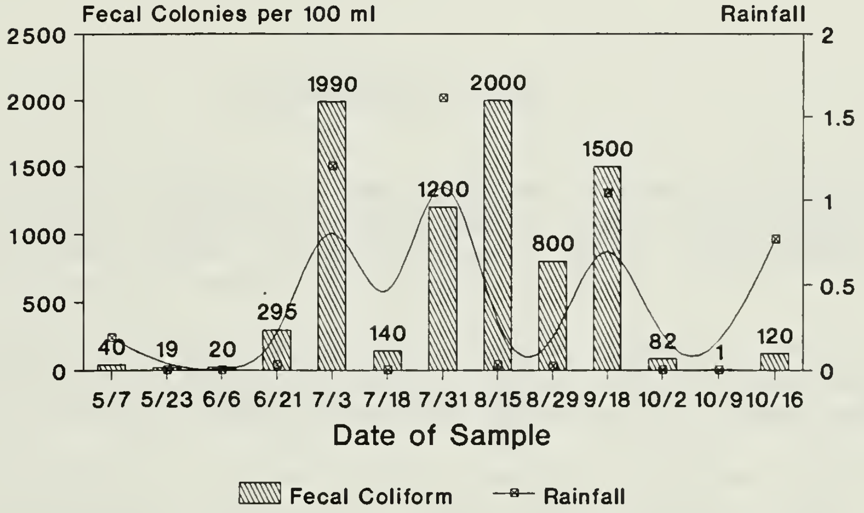
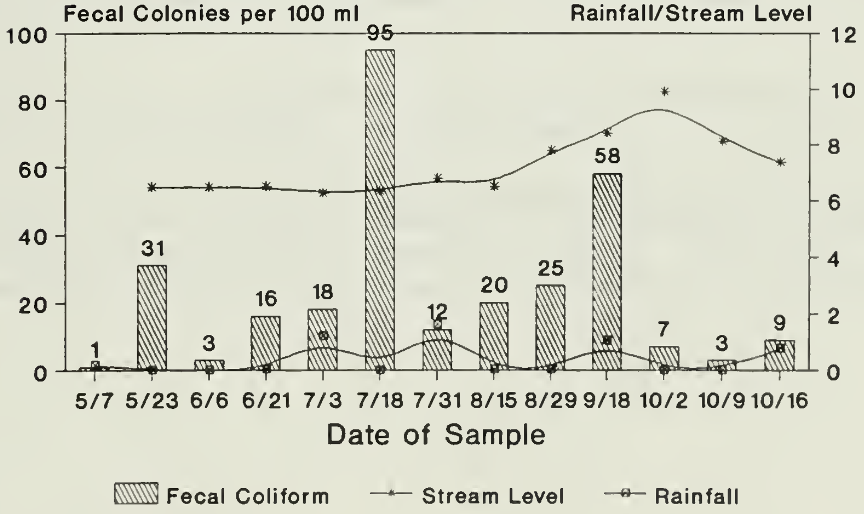


Figure 10. Fecal Coliform Data for the Gauley River at South Side Swiss



Take out at Mr. & Mrs. Kootnz

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APPENDICES

This section contains the appendices referred to in the paper. In Appendix 7 and 8 the 0.0 values for dissolved oxygen are not accurate. The data base program printed zeros in place of blank spaces. The 0.0 represent periods when the DO meter was being serviced. The following is a key to the abbreviations used in Appendix 6 - 9.

SITE_NO	Site Number
SITE_NAME	Site Name
DATE	Date
TIME	Time
WATER_TEMP	Water Temperature (in celsius)
F_100ML	Fecal coliform colonies per 100 mls of sample
AIR_TEMP	Air Temperature (in celsius)
PH	pH
STREAM_LVL	Stream level
WATER_COND	Water condition
INCUBATION	The amount of time the fecal coliform colonies were incubated in the hot water bath
DISS_OXYGN	Dissolved oxygen
DILUTIONS	The dilutions used to get the accepted fecal coliform colony reading (20 - 60)
WEATHER	Weather (referred to in appendix - 2)
PRECIP_48	Precipitation in the 48 hour period preceding the date listed

Appendix 1

This is an example sheet of the data collected when each site was sampled. Conductivity units are micro ohms. The top numbers in the dilution column are the milliliters of sample used and the numbers below them are the fecal coliform colony count.

SAMPLE SITE	DATE	SAMPLE TIME	WATER TEMP	AIR TEMP	pH	STAGE LEVEL	WATER COND	DO	WEATHER	CONDUC TIVITY	DILUTIONS		FECALS /100ML	COMMENTS
9. PINEY CREEK @ McCREERY	8/21/91	8:20	20°C	15°c	7.0	8.28	L,M,C	8.4	overcast	358	10 125	5 66	Est. 1320	
8. NEW RIVER @ PRINCE	8/21/91	8:40	26°C	18°C	7.9	1.9	L,M,C	7.2	overcast	150	100 12	150 24	16/100	
7. LAUREL CREEK @ QUINNMNT	8/21/91	9:00	19°C	18°C	7.7	5.75	L,M,C	8.8	overcast drizzle	145	100 2	50 2	Est. 2	
6. MEADOW CREEK	8/21/91	10:00	21°C	19°C	7.9	0.86	L,M,C	7.8	Overcast	225	30 11	20 15	Est. 75	
5. LICK CREEK	8/21/91	10:15	20°C	22°C	7.7	1.40	L,S,C	5.7	Partly Cloudy	400	35 26	25 12	26	
4. NEW RIVER @ SANDSTNE	8/21/91	10:50	24.5°C	24°C	8.7	1.90	L,M,C	6.4	sunny slightly overcast	140	.2 0	10 7	Est. 70	Hinton STP no longer on Line (old STP)
3. NEW RIVER @ HINT STP	8/21/91	12:30	25°C	28°C	8.9	1.90	L,M,C	6.9	sunny Part cloudy	150	100 19	50 4	Est 19	
2. MADAM CREEK	8/21/91	1:00	22°C	27°C	8.1	—	L,S,C	4.7	sunny slightly over	280	1 193	.5 120	Est. 24,000	
1. NEW RIVER @ HINTN VC	8/21/91	11:15	26°C	22°C	8.0	1.90	L,M,C	5.8	overcast	155	150 47	100 26	Est. 36.5	
									Pre-control Post-control		0 0	0 0		

HINTON GAGE	1.9
PRECIP W/IN 48 HOURS	0.0

OTHER OBSERVATIONS AND COMMENTS:

TIME IN: 5:20 pm
TIME OUT: 4:15pm

Appendix 2

This chart was used to determine weather codes when sampling.

WEATHER CODES

I. CLOUD AMOUNT

CLR	CLEAR: LESS THAN 1% SKY COVER
SCT	SCATTERED: 1% TO 50% SKY COVER
BKN	BROKEN: 60% TO 90% SKY COVER
OVC	OVERCAST: MORE THAN 90% SKY COVER
-	THIN (WHEN PREFIXED TO THE ABOVE SYMBOLS)
-X	PARTIAL OBSCURATION: 1% TO LESS THAN 10% SKY HIDDEN BY PRECIPITATION OR OBSTRUCTION TO VISION
X	OBSCURATION: 10% SKY HIDDEN BY PRECIPITATION OR OBSTRUCTION TO VISION

II. PHYSICAL WEATHER:

A. WEATHER AND OBSTRUCTION TO VISION SYMBOLS

A	HAIL
BS	BLOWING SNOW
D	DUST
F	FOG
GF	GROUND FOG
H	HAZE
K	SMOKE
L	DRIZZLE
R	RAIN
RW	RAIN SHOWERS
S	SNOW
SW	SNOW SHOWERS
T	THUNDERSTORMS
T+	SEVERE THUNDERSTORMS
ZL	FREEZING DRIZZLE
ZR	FREEZING RAIN

B. PRECIPITATION INTENSITIES

(-)	LIGHT
(NO SIGN)	MODERATE
(+)	HEAVY

Stream Conditions

First letter (volume):	Second letter(s) (velocity):	Third letter(s) (opacity):
L = low	SL = slow	C = clear
N = normal	M = moderate	MI = milky
H = high	SW = swift	MR = murky

Appendix 3

Phone numbers used to determine New River stage levels at Thurmond and Hinton.

GAUGES

Following is a list of non-battery operated gauges for several area rivers. The WVWA answering service will carry levels of selected rivers when they are at paddling levels.

PHONE	RIVERS	COMMENTS
466-0156	NEW (Bluestone Dam release)	Updated 8:00 AM each day.
529-5127	NEW & GAULEY Watersheds	Updated 10:00 AM each day.

(Stage, flow & 24-hour change on all gauging stations on Bluestone, Greenbrier, Cranberry, Elk & Meadow, plus New & Gauley.)

Appendix4

Table of Fecal Coliform Values for the Bluestone National Scenic River Fecal Coliform Study, April to September, 1991. Stage level and 48 hour precipitation are listed with corresponding dates and sample locations.

SITE NUMBER	SITE NAME	DATE	FECAL COLIFORM PER 100ml OF SAMPLE	STREAM LEVEL	48 HOUR PRECIPITATION
1T	LITTLE BLUESTONE	05/16/91	168		0.23
		* 05/28/91	1400		0.00
		e 06/10/91	100		0.00
		e 06/25/91	38		0.17
		07/08/91	63		TRACE
		e 07/22/91	32		0.00
		e 08/05/91	12		0.00
		e 08/19/91	3		TRACE
		e 09/04/91	5.5		0.06
		e 09/24/91	10		
2M	BLUESTONE	* 05/16/91	240		0.23
		* 05/28/91	2250		0.00
		e 06/10/91	160	3.2	0.00
		* 06/25/91	208	2.45	0.17
		07/08/91	33	2.4	TRACE
		e 07/22/91	5	2.1	0.00
		e 08/05/91	5	2.1	0.00
		e 08/19/91	9	2.0	TRACE
		e 09/04/91	10	1.9	0.06
		09/24/91	13		
3M	PIPESTEM	05/16/91	100		0.23
		05/28/91	100		0.00
		e 06/10/91	47	3.2	0.00
		06/25/91	89	2.45	0.17
		07/08/91	32	2.4	TRACE
		e 07/22/91	0	2.1	0.00
		e 08/05/91	10	2.1	0.00
		08/19/91	17	2.0	TRACE
		e 09/04/91	12	1.9	0.06
		e 09/24/91	35		
4M	CONFLUENCE	* 05/28/91	1900		0.00
		e 06/10/91	60	3.2	0.00
		06/25/91	62	2.45	0.17
		07/08/91	24	2.4	TRACE
		e 07/22/91	11	2.1	0.00
		e 08/05/91	26	2.1	0.00
		08/19/91	9	2.0	TRACE
		e 09/04/91	11.5	1.9	0.06
		e 09/24/91	17		

The FECAL COLIFORM PER 100ml OF SAMPLE means the number of fecal coliform colonies counted on the membrane filter and then adjusted for 100ml of sample.

> Means that the value is estimated as being greater than the one displayed.
< Means that the value is estimated as being less than the one dispalyed.
* Indicates values greater than 200 counts per 100ml.
e Indicates that the value is estimated.

Appendix 5

Table of Fecal Coliform Values for the Gauley River National Recreation Area Fecal Coliform Study, April to October, 1991. Stage level and 48 hour precipitation are listed with corresponding dates and sample locations.

SITE NUMBER	SITE NAME	DATE	FECAL COLIFORM PER 100ml OF SAMPLE	STREAM LEVEL	48 HOUR PRECIPITATION
1M	SUMMERSVILLE DAM	05/07/91	e 1	190CFS	0.19"
		05/23/91	e 0	190CFS	0.00"
		06/06/91	e 0	192CFS	0.00"
		06/21/91	0.42	NORMAL	0.03"
		07/03/91	e 1	158csf	1.20"
		07/18/91	e 0.50	1356.3	0.00"
		07/31/91	e 6	1356.5	1.61"
		08/15/91	e 1.75	1356.9	0.03"
		08/29/91	e 0.25	1357.8	0.02"
		09/18/91	e 0.33	1358.4	1.04"
		10/02/91	e 8	1938.2	0.00"
		10/09/91	e 0.28	1358.1	0.00"
		10/16/91	e 2.40	NORMAL	0.77"
2M	MID GAULEY	05/23/91	33	190CFS	0:00
		06/06/91	e 1	192CFS	0.00"
		06/21/91	e 46	NORMAL	0.03"
		07/03/91	e 6.70	NORMAL	1.20"
		07/18/91	e 10.50	LOW	0.00"
		07/31/91	e 27	NORMAL	1.61"
		08/15/91	* e 275	NORMAL	0.03"
		08/29/91	e 7.7	NORMAL	0.02"
		09/18/91	e 29.51	HIGH	1.04"
		10/02/91	e 1	HIGH	0.00"
		10/09/91	e 41	NORMAL	0.00"
		10/16/91	e 31	LOW	0.77"
3T	PETERS CREEK	05/07/91	e 40	000000	0.19"
		05/23/91	e 19	109CFS	0.00"
		06/06/91	e 20.5	192CFS	0.00"
		06/21/91	* e 295	HIGH	0.03"
		07/03/91	* e 1990	NORMAL	1.20"
		07/18/91	e 140	LOW	0.00"
		07/31/91	* e 1200	HIGH	1.61"
		08/15/91	* e 10666.7	NORMAL	0.03"
		08/29/91	* e 800	LOW	0.02"
		09/18/91	* e 1500	NORMAL	1.04"
		10/02/91	e 82	LOW	0.00"
		10/09/91	e 1.3	LOW	0.00"
		10/16/91	e 120	NORMAL	0.77"
4M	SOUTH SIDE SWISS	05/07/91	e 1	000000	0.19"
		05/23/91	e 31	190CFS	0.00"
		06/06/91	e 3	192CFS	0.00"
		06/21/91	e 16	NORMAL	0.03"
		07/03/91	e 18	NORMAL	1.20"
		07/18/91	e 95.3	LOW	0.00"
		07/31/91	e 12	NORMAL	1.61"
		08/15/91	e 20.2	NORMAL	0.03"
		08/29/91	e 25.7	NORMAL	0.02"
		09/18/91	e 58.51	HIGH	1.04"
		10/02/91	e 7	HIGH	0.00"

10/9/91	e 3.5	Nor
10/16/91	e 9.6	Low

The FECAL COLIFORM PER 100mll OF SAMPLE means the number of fecal coliform colonies counted on the membrane filter and then adjusted for 100ml of sample.

> Means that the value is estimated as bing greater than the one displayed.

< Means that the value is estimated as being less than the one displayed.

* Indicates values greater than 200 counts per 100ml.

e Indicates that the value is estimated.

Appendix 6

Raw data for the BLUE fecal coliform study, April-September, 1991.

SITE_NAME	DATE	TIME	FC_100ML	WATER_TEMP	AIR_TEMP	PH	STREAM_LVL	WATER_COND	INCUBATION	DISS_OXYGN	DILUTIONS	WEATHER	PRECIP_4
LITTLE BLUESTONE	05/16/91	10:20	155	15.5	22	6.40		MILKY	22:42	3.00	50ML:82 25ML:43	CLEAR	0.23
LITTLE BLUESTONE	05/28/91	1:33	1400	21.0	26	7.10		SLIGHTLY TURBID	22:18	8.70	1ML:14 5ML:13	SUNNY	0.00
LITTLE BLUESTONE	06/10/91	1:42	100	18.0	23	7.30		MOSTLY CLEAR	22:45	0.00	5ML:5 10ML:4	SUNNY	0.00
LITTLE BLUESTONE	06/25/91	1:31	28	19.0	21	7.50		NORMAL, MODERATE, CLEAR	22:58	0.00	20ML:11 40ML:15	OVERCAST	0.17
LITTLE BLUESTONE	07/08/91	12:55	62	24.5	26	7.70		LOW, MODERATE, CLEAR	22:41	0.00	40ML:25 60ML:16	SCATTERED CLOUDS	TRACE
LITTLE BLUESTONE	07/22/91	10:37	32	23.5	29	7.10		LOW, MODERATE, CLEAR	22:00	0.00	50ML:16 50ML:6	SCATTERED CLOUDS	0.00
LITTLE BLUESTONE	08/05/91	9:42	12	22.0	20	7.00		LOW, MODERATE, CLEAR	25:42	6.60	40ML:4 50ML:6	CLEAR	0.00
LITTLE BLUESTONE	08/19/91	2:20	3	27.0	33	9.90		LOW, MODERATE, CLEAR	22:15	7.50	150ML:3 200ML:6	CLEAR	TRACE
LITTLE BLUESTONE	09/04/91	10:16	5	20.0	21	0.00		LOW, SLOW, CLEAR	24:00	6.00	250ML:10 200ML:11	OVERCAST -	0.06
LITTLE BLUESTONE	09/24/91	12:41	10	17.5	23	7.00		LOW, MODERATE, CLEAR	24:00	8.40	100ML:5 100ML:10	OVERCAST	
BLUESTONE	05/16/91	11:43	240	15.0	24	7.30		TURBID	22:42	5.40	25ML:205 25ML:242	CLEAR	0.23
BLUESTONE	05/28/91	12:22	2250	19.5	25	7.10		TURBID, HIGH FLOW	22:16	9.40	1ML:37 5ML:40	MOSTLY SUNNY	0.00
BLUESTONE	06/10/91	11:41	160	21.0	23	8.00	3.2	SLIGHTLY MILKY	22:45	0.00	1ML:3 5ML:8	SUNNY	0.00
BLUESTONE	06/25/91	11:35	208	21.0	21	7.70	2.45	NORMAL, SLOW, MURKY	22:56	0.00	15ML:24 20ML:51	OVERCAST	0.17
BLUESTONE	07/08/91	11:15	33	29.0	29	9.00	2.4	LOW, SWIFT, CLEAR	22:41	0.00	15ML:4 15ML:5	SCATTERED CLOUDS	TRACE
BLUESTONE	07/22/91	1:09	5	30.5	29	9.00	2.1	LOW, MODERATE, CLEAR	22:00	0.00	20ML:1 30ML:0	SCATTERED CLOUDS	0.00
BLUESTONE	08/05/91	11:05	5	27.0	27	8.90	2.1	LOW, SLOW, CLEAR	25:42	8.60	100ML:4 100ML:5	CLEAR	0.06
BLUSTONE	08/19/91	12:30	9	27.0	26	9.00	2.0	LOW, SWIFT, CLEAR	22:15	9.40	200ML:18 250ML:17	SCATTERED CLOUDS	TRACE
BLUESTONE	09/04/91	11:45	10	23.0	25	8.40	1.9	LOW, MURKY, CLEAR	24:00	9.40	250ML:16 200ML:20	OVERCAST	0.06
BLUESTONE	09/24/91	10:01	13	18.5	20	8.40		LOW, SWIFT, CLEAR	24:00	1.09	250ML:25 200ML:35	OVERCAST	
PIPESTEM	05/16/91	1:05	100	20.0	25	7.40		TURBID	22:42	8.50	25ML:166 25ML:14	PARTLY CLOUDLY	0.23
PIPESTEM	65/28/91	10:57	100	20.6	30	6.90		TURBID, HIGH FLOW	22:16	9.40	1ML:6 5ML:5	MOSTLY SUNNY	0.00
PIPESTEM	06/10/91	10:15	47	19.0	23	8.10	3.2	SLIGHTLY MILKY	22:45	0.00	10ML:2 30ML:14	SUNNY	0.00
PIPESTEM	06/25/91	10:24	89	20.6	19	7.80	2.45	NORMAL, MODERATE, MURKY	22:58	0.00	50ML:46 75ML:61	OVERCAST	0.17
PIPESTEM	07/08/91	10:07	32	26.5	26	8.40	2.4	LOW, MODERATE, CLEAR	22:41	0.00	25ML:8 50ML:8	BROKEN CLOUDS	TRACE
PIPESTEM	07/22/91	2:13	0	30.5	33	8.70	2.1	LOW, SLOW, CLEAR	22:00	0.00	60ML:0 70ML:6	SCATTERED CLOUDS	0.00
PIPESTEM	08/05/91	12:07	10	26.0	26	8.80	2.1	LOW, SLOW, CLEAR	25:42	9.20	100ML:10 100ML:10	SCATTERED CLOUDS	0.00
PIPESTEM	08/19/91	11:26	17	25.0	28	8.80	2.0	LOW, SLOW, CLEAR	22:15	1.01	200ML:22 100ML:23	SCATTERED CLOUDS	TRACE
PIPESTEM	09/04/91	12:45	12	22.6	28	8.40	1.9	LOW, SLOW, CLEAR	24:00	1.00	200ML:25 150ML:6	OVERCAST	0.06
PIPESTEM	09/24/91	11:00	35	18.6	20	8.40		LOW, MODERATE, CLEAR	24:00	1.06	200ML:61 150ML:53	OVERCAST	
CONFLUENCE	05/28/91	1:48	1900	20.6	26	7.10		TURBID	22:16	0.00	5ML:55 1ML:27	SUNNY	0.00
CONFLUENCE	06/10/91	1:53	60	21.0	23	8.10	3.2	MOSTLY TURBID	22:45	9.20	1ML:0 5ML:3	SUNNY	0.00
CONFLUENCE	06/25/91	1:40	62	21.0	21	8.20	2.45	NORMAL, SLOW, MURKY	22:58	0.00	25ML:12 50ML:31	OVERCAST	0.17
CONFLUENCE	07/08/91	1:10	24	29.6	28	8.40	2.4	LOW, SLOW, MURKY	22:41	0.00	50ML:4 70ML:17	SCATTERED CLOUDS	TRACE
CONFLUENCE	07/22/91	10:46	11	28.0	27	8.30	2.1	LOW, SLOW, MURKY	22:00	0.00	70ML:6 100ML:11	SCATTERED CLOUDS	0.00
CONFLUENCE	08/05/91	9:56	26	26.6	22	8.60	2.1	LOW, SLOW, CLEAR	25:42	5.50	100ML:31 100ML:20	CLEAR	0.00
CONFLUENCE	08/19/91	2:00	9	27.0	28	7.00	2.0	LOW, SLOW, MURKY	22:15	7.00	100ML:9 150ML:7	SCATTERED CLOUDS -	TRACE
CONFLUENCE	09/04/91	10:30	11	21.5	22	8.00	1.9	LOW, SLOW, MURKY	24:00	8.00	250ML:23 200ML:27	OVERCAST -	0.06
CONFLUENCE	09/24/91	12:56	17	18.0	23	7.90		LOW, SLOW, CLEAR	24:00	8.60	250ML:43 200ML:64	OVERCAST	

Appendix 7

Raw data for the GARI fecal coliform study, April-September, 1991.

te No. 1
02/91

SITE_NAME	DATE	TIME	WATER_TEMP	FC_100ML	AIR_TEMP	PH	STREAM_LVL	WATER_COND	INCUBATION	DISS OXYGN	DILUTIONS	WEATHER
SUMMERSVILLE DAM	05/07/91	12:20	9.0	1	18	0.00	190CFS	CLEAR	22:00	0.00	100mL:1 100mL:1	SUNNY. CLEAR
SUMMERSVILLE DAM	05/23/91	3:50	11.0	0	79	5.40	190CPS	CLEAR-	22:04	0.00	100mL:1 100mL:0	RAINING
SUMMERSVILLE DAM	06/06/91	1:00	0.0	0	0	5.10	192CFS	CLEAR	23:00	0.00	200mL:1 200mL:1	SUNNY
SUMMERSVILLE DAM	06/21/91	2:20	11.0	0	0	6.40	NORMAL	CLEAR	22:15	0.00	240mL:1 240mL:1	SCATTERED HAZE
SUMMERSVILLE DAM	07/03/91	12:58	12.0	1	0	6.60	158cfs	NORMAL. MODERATE. CLEAR	22:05	0.00	400ml:2 400ml:5	OVERCAST. HAZE
SUMMERSVILLE DAM	07/18/91	12:15	12.0	0	30	6.50	1356.8	LOW. SLOW. CLEAR	22:45	0.00	400ML:1 400ML:2	SCATTERED CLOUDS
SUMMERSVILLE DAM	07/31/91	12:30	11.0	6	29	6.90	1356.5	NORMAL. MODERATE. CLEAR	23:10	0.00	400ML:21 400ML:27	SCATTERED CLOUDS. HAZE
SUMMERSVILLE DAM	08/15/91	12:50	11.0	1	27	6.80	1356.9	NORMAL. MODERATE. CLEAR	22:55	8.60	400ML:7 300ML:3	SCATTERED CLOUDS. HAZE-
SUMMERSVILLE DAM	08/29/91	1:00	13.0	0	37	5.50	1357.8	NORMAL. SWIFT. CLEAR	23:15	0.00	400ML:1	SCATTERED CLOUDS
SUMMERSVILLE DAM	09/18/91	11:30	15.0	0	30	6.90	1358.4	NORMAL. SWIFT. CLEAR	23:00	0.00	300ML:0 250ML:0	SUNNY. HAZE
SUMMERSVILLE DAM	10/02/91	9:38	19.0	8	18	7.50	1938.2	HIGH. SWIFT. CLEAR	24:00	9.20	100ML:0 125ML:1	SUNNY. HAZE-
SUMMERSVILLE DAM	10/09/91	1:00	21.0	0	22	7.70	1358.1	MODERATE. CLEAR	23:30	8.80	350ML:1 250ML:0	SUNNY. CLEAR
SUMMERSVILLE DAM	10/16/91	12:15	18.0	2	10	7.40	NORMAL	MODERATE. CLEAR	23:15	8.60	275ML:4 250ML:6	OVERCAST+
MID GAULEY	05/23/91	24:55	22.0	33	82	7.30	190CFS	TURBID	22:04	8.60	100mL:37 50mL:13	PARTLY CLOUDY
MID GAULEY	06/06/91	11:21	0.0	1	70	7.00	192CFS	CLEAR	23:00	0.00	100mL:2 100mL:1	SUNNY
MID GAULEY	06/21/91	2:00	25.0	46	0	7.00	NORMAL	MURKY	22:15	0.00	50mL:23 150mL:89	SCATTERED HAZE
MID GAULEY	07/03/91	11:27	0.0	6	0	7.00	NORMAL	MODERATE, CLEAR, MILKY	22:05	0.00	100ml:9 150ml:10	OVERCAST. HAZE
MID GAULEY	07/18/91	11:22	27.0	10	32	7.20	LOW	LOW, SLOW, MILKY	22:45	0.00	150ML:19 200ML:21	SCATTERED CLOUDS.
MID GAULEY	07/31/91	10:55	20.5	27	29	6.90	NORMAL	NORMAL, MODERATE, MURKY	23:10	9.20	200ML:40 150:51	OVERCAST, HAZE-
MID GAULEY	08/15/91	11:55	20.0	275	28	6.80	NORMAL	MODERATE, MURKY	22:55	9.60	150ML:TNTC 100ML:275	SCATTERED CLOUDS, HAZE-
MID GAULEY	08/29/91	12:30	19.0	7	32	6.90	NORMAL	SLOW, MILKY	23:15	0.00	350ML:27	CLEAR
MID GAULEY	09/18/91	10:30	17.0	29	25	7.70	HIGH	MODERATE, MILKY	23:00	0.00	150ML:51 100ML:25	SUNNY, HAZE-
MID GAULEY	10/02/91	10:25	20.0	1	18	7.60	HIGH	MODERATE, CLEAR	24:00	9.00	100ML:1 50ML:0	SUNNY, HAZE-
MID GAULEY	10/09/91	11:30	18.0	41	19	7.60	NORMAL	MODERATE, CLEAR	23:30	9.40	250ML:115 200ML:82	SUNNY, CLEAR
MID GAULEY	10/16/91	11:35	16.0	31	12	7.20	LOW	MODERATE, CLEAR	23:15	8.60	225ML:63 200ML:62	SCATTERED CLOUDS
PETERS CREEK	05/07/91	11:00	15.0	40	20	0.00	000000	MILKY	22:00	0.00	100ml:41 125ml:49	SUNNY, CLEAR
PETERS CREEK	05/23/91	2:55	23.0	19	80	8.10	109CFS	MILKY	22:04	7.80	75mL:12 50mL:13	PARTLY CLOUDY
PETERS CREEK	06/06/91	11:34	0.0	20	70	7.60	192CFS	MILKY	23:00	0.00	100mL:20 100mL:21	SUNNY
PETERS CREEK	06/21/91	2:15	24.0	295	0	7.70	HIGH	TURBID	22:15	0.00	20mL:59 30mL:97	SCATTERED HAZE
PETERS CREEK	07/03/91	11:53	0.0	1990	0	8.00	NORMAL	MODERATE, TURBID	22:05	0.00	10ML:199 25ML:TNTC	OVERCAST, HAZE-
PETERS CREEK	07/18/91	11:37	25.0	148	32	8.10	LOW	LOW, SLOW, MURKY	22:45	0.00	5ML:7 0ML:3	SCATTERED CLOUDS
PETERS CREEK	07/31/91	11:15	21.0	1200	28	7.50	HIGH	SWIFT, TURBID	23:10	9.00	8ML:TNTC 5ML:TNTC	SCATTERED CLOUDS, HAZE-
PETERS CREEK	08/15/91	11:30	21.0	10666	27	7.50	NORMAL	MODERATE, TURBID	22:55	9.00	.3ML:32 .1ML:12	SCATTERED CLOUDS, HAZE-
PETERS CREEK	08/29/91	12:00	24.0	800	26	6.90	LOW	SLOW, MURKY	23:15	8.40	.5ML:4 .3ML:3	CLEAR
PETERS CREEK	09/18/91	10:45	22.0	1500	24	8.10	NORMAL	MODERATE, TURBID	23:00	8.80	.4ML:6 .2ML:1	SUNNY, HAZE-
PETERS CREEK	10/02/91	10:37	16.0	82	18	7.80	LOW	SLOW, MILKY	24:00	9.20	75ML:62 50ML:41	SUNNY, HAZE-
PETERS CREEK	10/09/91	12:00	11.0	1	15	7.80	LOW	SLOW, MILKY	23:30	0.00	75ML:1 50ML:0	SUNNY, CLEAR
PETERS CREEK	10/16/91	11:15	11.0	120	12	6.50	NORMAL	MODERATE, MURKY	23:15	0.00	75ML:TNTC 50ML:TNTC	SCATTERED CLOUDS
SOUTH SIDE SWISS	05/07/91	10:20	18.0	1	19	0.00	000000	CLEAR	22:00	0.00	100ml:1 100ml:1	SUNNY, CLEAR
SOUTH SIDE SWISS	05/23/91	1:10	21.0	31	76	6.80	190CFS	TURBID	22:04	8.80	100mL:32 100mL:29	PARTLY CLOUDY
SOUTH SIDE SWISS	06/06/91	10:15	0.0	3	70	7.10	192CFS	CLEAR	23:00	0.00	100mL:3 100mL:3	SUNNY
SOUTH SIDE SWISS	06/21/91	10:20	25.0	16	0	7.10	NORMAL	MILKY	22:15	0.00	50mL:9 100mL:16	SCATTERED HAZE-
SOUTH SIDE SWISS	07/03/91	10:40	28.0	18	0	7.30	NORMAL	MORDERATE. MILKY	22:05	0.00	100ML:13 150ML:27	OVERCAST. HAZE-
SOUTH SIDE SWISS	07/18/91	9:52	27.0	95	27	7.60	LOW	LOW. SLOW. MILKY	22:45	0.00	150ML:143 200ML:TNTC	CLEAR
SOUTH SIDE SWISS	07/31/91	10:13	23.0	12	22	6.70	NORMAL	MODERATE. MURKY	23:10	8.60	150ML:18 100ML:11	OVERCAST. HAZE+
SOUTH SIDE SWISS	08/15/91	10:35	22.0	20	28	7.20	NORMAL	MODERATE. MILKY	22:55	8.60	150ML:29 100ML:21	OVERCAST. HAZE-
SOUTH SIDE SWISS	08/29/91	10:00	19.0	25	34	6.60	NORMAL	SLOW. MILKY	23:15	9.00	150ML:38 100ML:26	CLEAR
SOUTH SIDE SWISS	09/18/91	9:45	17.0	59	25	6.90	HIGH	MODERATE. MURKY	23:00	0.00	100ML:59 50ML:29	HAZE+
SOUTH SIDE SWISS	10/02/91	11:31	21.0	7	23	7.70	HIGH	SLOW. TURBID	24:00	9.00	100ML:2 100ML:7	SUNNY. CLEAR
SOUTH SIDE SWISS	10/09/91	10:40	18.0	3	18	7.60	NORMAL	MODERATE. MILKY	23:30	9.20	250ML:5 200ML:7	SUNNY. CLEAR
SOUTH SIDE SWISS	10/18/91	10:35	16.0	9	12	6.50	LOW	SLOW. CLEAR	23:15	8.80	250ML:24 200ML:15	OVERCAST+

Appendix 8

Comments associated with Appendix 6.

SITE_NO	SITE_NAME	DATE	COMMENTS
1T	LITTLE BLUESTONE	05/16/91	YELLOW GROWTH APPEARED IN 50ML DILUTION DISH.
1T	LITTLE BLUESTONE	05/28/91	BOTH REPS: BACTERIAL GROWTH IN RING AROUND EDGE OF GRID: NO GROWTH IN CENTER(SEDIMENT).
1T	LITTLE BLUESTONE	06/10/91	FC/100ML IS ESTIMATED. DISSOLVED OXYGEN=12.9MG/L
1T	LITTLE BLUESTONE	06/25/91	ESTIMATED FECAL COUNT: CONDUCT.=70
1T	LITTLE BLUESTONE	07/08/91	COND.=118
1T	LITTLE BLUESTONE	07/22/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 140
1T	LITTLE BLUESTONE	08/05/91	FC/100 IS ESTIMATED. CONDUTIVITY IS 125
1T	LITTLE BLUESTONE	08/19/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 150.
1T	LITTLE BLUESTONE	09/04/91	FC/100ML IS ACTUALLY 5.5 AND IS ESTIMATED. COND IS 170
1T	LITTLE BLUESTONE	09/24/91	FC/100ML IS ESTIMATED. COND IS 145. BOTTLE LEAKED OUT, LOST 1/2 SAMPLE.
2M	BLUESTONE	05/16/91	FECAL COUNT >240 BOTH 25ML DILUTIONS CONTAIN MUCH PARTCULATE MATTER:YELLOW GROWTH PRES.F-C/100 EST.
2M	BLUESTONE	05/28/91	BOTH SAMPLES: BACTERIAL GROWTH IN RING AROUND EDGE OF GRID: NO GROWTH IN CENTER(SEDIMENT).
2M	BLUESTONE	06/10/91	FC/100ML IS ESTIMATED. DISSOLVED OXYGEN=13.9MG/L
2M	BLUESTONE	06/25/91	CONDUCT.=215
2M	BLUESTONE	07/08/91	COND.=335
2M	BLUESTONE	07/22/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 335.
2M	BLUESTONE	08/05/91	FC/100 IS ESTIMATED. CONDUTIVITY IS 350.
2M	BLUSTONE	08/19/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 315.
2M	BLUESTONE	09/04/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 365.
2M	BLUESTONE	09/24/91	COND IS 290. DISSOLVED OXYGEN IS ACTUALLY 10.9.
3M	PIPESTEM	05/16/91	BOTH REPS. WITH YELLOW GROWTH AND PARTICULATE MATTER.
3M	PIPESTEM	05/28/91	EACH SAMPLE RINSED WITH 60MLS OF BUFFER SOLN. NO BACTERIA GROWTH IN 1ML. HIGH AMT. OF SEDIMENT.
M	PIPESTEM	06/10/91	FC/100ML IS ESTIMATED. DISSOLVED OXYGEN=14.2MG/L.
M	PIPESTEM	06/25/91	CONDUCTIVITY IS 220.
M	PIPESTEM	07/08/91	CONDUCTIVITY IS 90. 50ML SAMPLE HAD WATER IN IT.
M	PIPESTEM	07/22/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 355.
M	PIPESTEM	08/05/91	FC/100 IS ESTIMATED. CONDUTIVITY IS 370.
M	PIPESTEM	08/19/91	THE PH FOR M03 SHOULD READ

SITE_NO	SITE_NAME	DATE	COMMENTS
			10.1. CONDUCTIVITY IS 325.
3M	PIPESTEM	09/04/91	FC/100ML IS ACTUALLY 12.5 AND IS ESTIMATED. CONDUCTIVITY IS 390.
3M	PIPESTEM	09/24/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 300. DISSOLVED OXYGEN IS ACTUALLY 10.6.
4M	CONFLUENCE	05/28/91	BOTH REPS: BACTERIAL GROWTH AROUND EDGE OF GRID ONLY. SAMPLES NOT DILUTED.
4M	CONFLUENCE	06/10/91	FC/100ML IS ESTIMATED.
4M	CONFLUENCE	06/25/91	CONDUCTIVITY IS 235.
4M	CONFLUENCE	07/08/91	CONDUCTIVITY IS 350.
4M	CONFLUENCE	07/22/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 325.
4M	CONFLUENCE	08/05/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 325.
4M	CONFLUENCE	08/19/91	CONDUCTIVITY IS 310.
4M	CONFLUENCE	09/04/91	FC/100ML IS ACTUALLY 12.5 AND IS ESTIMATED. CONDUCTIVITY IS 380.
4M	CONFLUENCE	09/24/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 300.

Appendix 9

Comments associated with Appendix 7.

SITE_NO	SITE_NAME	DATE	COMMENTS
1M	SUMMERSVILLE DAM	05/07/91	SUMMERSVILLE LAKE LEVEL @ 1643 FC/100 IS ESTIMATED
1M	SUMMERSVILLE DAM	05/23/91	NO READING TAKEN WITH THE DO METER. FC/100ML WAS ESTIMATED AT 0.5/100ML.
1M	SUMMERSVILLE DAM	06/06/91	TEMP. GUAGE OUT OF ORDER.DO METER NOT WORKING. FC/100 IS ESTIMATED AT 0.5/100ML
1M	SUMMERSVILLE DAM	06/21/91	FC/100ML WAS 0.42/100ML. DO METER NOT USED. COUNT IS .42/100ML CONDUCTIVITY IS 30.
1M	SUMMERSVILLE DAM	07/03/91	DO METER NOT USED. FC/100ML IS ESTIMATED AT 1.25/100ML.
1M	SUMMERSVILLE DAM	07/18/91	DO METER NOT USED. FC/100ML IS ESTIMATED AT 0.5/100ML. CONDUCTIVITY IS 30.
1M	SUMMERSVILLE DAM	07/31/91	DO READING 11.2. FC/100ML IS ESTIMATED. CONDUCTIVITY IS 32. S.D.GAGE 1356.5
1M	SUMMERSVILLE DAM	08/15/91	FC/100ML IS ESTIMATED AT 1.75/100ML. CONDUCTIVITY 33. DO READING 11.8MG/L. S.DAM GAGE 1356.93.
1M	SUMMERSVILLE DAM	08/29/91	FC/100ML IS ESTIMATED AT 0.25/100ML. CONDUCTIVITY IS 33. DO READING=11.2.
1M	SUMMERSVILLE DAM	09/18/91	FC/100ML IS ESTIMATED AT 0.33/100ML. CONDUCTIVITY IS 60. DO READING=11.2
1M	SUMMERSVILLE DAM	10/02/91	FC/100ML IS ESTIMATED. CONDUCTIVITY 11. 1900 CFS DISCHARGE FROM DAM
1M	SUMMERSVILLE DAM	10/09/91	FC/100ML IS ESTIMATED AT 0.28/100ML. CONDUCTIVITY IS105. DAM 1950 CFS
1M	SUMMERSVILLE DAM	10/16/91	FC/100ML IS ESTIMATED AT 2.4/100ML. CONDUCTIVITY IS 110. DAM 1243 CFS
2M	MID GAULEY	05/23/91	
2M	MID GAULEY	06/06/91	TEMP. GAUGE AND DO METER OUT OF ORDER. FC/100ML IS ESTIMATED.
2M	MID GAULEY	06/21/91	RIVER LEVEL 147.6. DO METER NOT USED. FC/100ML IS ESTIMATED. CONDUCTIVITY IS 95.
2M	MID GAULEY	07/03/91	DO AND TEMP METERS NOT USED. FC/100ML IS ESTIMATED AT 6.7/100ML.
2M	MID GAULEY	07/18/91	DO METER NOT USED. FC/100ML IS ESTIMATED AT 10.5/100ML. CONDUCTIVITY IS 80.
2M	MID GAULEY	07/31/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 70.
2M	MID GAULEY	08/15/91	FC/100ML IS ESTIMATED. CONDUCTIVITY 80.
2M	MID GAULEY	08/29/91	FC/100ML IS ESTIMATED AT 7.7/100ML. CONDUCTIVITY IS 50. DO READING 10.0
2M	MID GAULEY	09/18/91	FC/100ML IS ESTIMATED AT

SITE_NO	SITE_NAME	DATE	COMMENTS
			29.51/100ML. CONDUCTIVITY IS 65. DO READING=10.6.
2M	MID GAULEY	10/02/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 110.
2M	MID GAULEY	10/09/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 102.
2M	MID GAULEY	10/16/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 95.
3T	PETERS CREEK	05/07/91	FC/100ML IS ESTIMATED.
3T	PETERS CREEK	05/23/91	FC/100ML IS ESTIMATED.
3T	PETERS CREEK	06/06/91	FC/100ML IS ESTIMATED AT 20.5. DO METER NOT USED. TEMP GAUGE NOT WORKING.
3T	PETERS CREEK	06/21/91	DO METER NOT USED. FC/100ML IS ESTIMATED. CONDUCTIVITY IS 460.
3T	PETERS CREEK	07/03/91	DO AND TEMP METERS NOT USED. FC/100ML IS ESTIMATED.
3T	PETERS CREEK	07/18/91	DO METER NOT USED. FC/100ML IS ESTIMATED. CONDUCTIVITY IS 400.
3T	PETERS CREEK	07/31/91	FC/100ML IS ESTIMATED. CONDUCTIVITY 300.
3T	PETERS CREEK	08/15/91	FC/100ML IS ESTIMATED AT 10666.7. CONDUCTIVITY 260.
3T	PETERS CREEK	08/29/91	FC/100ML IS ESTIMATED. COND IS 425.
3T	PETERS CREEK	09/18/91	FC/100ML IS ESTIMATED. CONDUCTIVITY 340.
3T	PETERS CREEK	10/02/91	FC/100ML IS ESTIMATED. CONDUCTIVITY 370.
3T	PETERS CREEK	10/09/91	FC/100ML IS ESTIMATED AT 1.3/100ML. CONDUCTIVITY 290. DO=11.8/MG.
3T	PETERS CREEK	10/16/91	FC/100ML IS ESTIMATED. CONDUCTIVITY 275. DO=10.1ML.
4M	SOUTH SIDE SWISS	05/07/91	FC/100ML IS ESTIMATED. M2 MID GAULEY.
4M	SOUTH SIDE SWISS	05/23/91	FC/100ML IS ESTIMATED.
4M	SOUTH SIDE SWISS	06/06/91	DO METER NOT USED. TEMP GAUGE NOT WORKING. FC/100ML IS ESTIMATED.
4M	SOUTH SIDE SWISS	06/21/91	DO METER NOT USED. FC/100ML IS ESTIMATED.
4M	SOUTH SIDE SWISS	07/03/91	DO METER NOT USED. FC/100ML IS ESTIMATED. CONDUCTIVITY 100.
4M	SOUTH SIDE SWISS	07/18/91	DO METER NOT USED. FC/100ML IS ESTIMATED AT 95.3/100ML. CONDUCTIVITY 105.
4M	SOUTH SIDE SWISS	07/31/91	FC/100ML IS ESTIMATED. CONDUCTIVITY IS 100.
4M	SOUTH SIDE SWISS	08/15/91	FC/100ML IS ESTIMATED AT 20.2/100ML. CONDUCTIVITY IS 100.
4M	SOUTH SIDE SWISS	08/29/91	FC/100ML IS ESTIMATED AT 25.7/100ML. CONDUCTIVITY IS 50.
4M	SOUTH SIDE SWISS	09/18/91	FC/100ML IS ESTIMATED AT 58.51/100ML. CONDUCTIVITY IS

SITE_NO	SITE_NAME	DATE	COMMENTS
			62. DO READING=10.2.
4M	SOUTH SIDE SWISS	10/02/91	FC/100ML IS ESTIMATED 7/100ML. CONDUCTIVITY IS 110.
4M	SOUTH SIDE SWISS	10/09/91	FC/100ML IS ESTIMATED 3.5/100ML. CONDUCTIVITY IS 100.
4M	SOUTH SIDE SWISS	10/16/91	FC/100ML IS ESTIMATED AT 9.6/100ML. CONDUCTIVITY IS 110.